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The ASK Model of Peer Tutoring: Theory and Research

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This paper proposes a model of peer tutoring for use in college classrooms. The peer tutor is conceptualized as a "coach" who guides and shapes students' learning. Three components of peer tutoring are considered: (1) the tutor's *attitude* toward teaching, (2) tutoring *skills* such as diagnosing (questioning, listening, and observing), intervening (prompting and clarifying), and evaluating (providing feedback and reinforcement), and (3) the tutor's *knowledge* of the subject. Thus, this is called the ASK model of peer tutoring. The model represents a synthesis of literature from three theoretical perspectives—behavioral, cognitive, and sociocognitive. Theory and research in these three areas are offered to support the model and its components.

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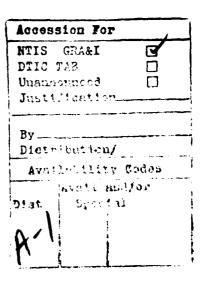| 17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UNLIMITED

Foreword

This work was conducted as part of the Navy Personnel Research and Development Center's independent research program (Program Element 0601152N, Work Unit 0601152N.R0001.04), which is sponsored by the Office of Naval Research (Code 20P). The goals of this project were to develop a model of on-the-job training and determine how shipboard enlisted supervisors conduct on-the-job training based on the prescriptions of the model.

This technical note is a review of the literature and the development of a model of peer tutoring. It is intended to provide background and technical information for the On-the-Job Training independent research project.

The authors wish to thank Melinda Kuti and Lisa Reboy for their feedback on earlier drafts of this manuscript. Thanks also go to Dick Culver who introduced us to some of the ideas developed in this paper and stimulated us to apply them to peer tutoring.

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Summary

The ASK model defines three components of effective peer tutoring: a positive *attitude* toward teaching, tutoring *skills* (listening, observing, prompting, clarifying, providing feedback, and reinforcing), and tutors's *knowledge* of the subject. It is hypothesized that knowledge and attitude are boundary conditions, requiring a threshold level for tutoring to be effective, and that skills moderate the effects of knowledge and attitude in tutoring interactions. The tutor is conceptualized as a "coach" who guides and shapes students' learning.

The goal of an effective tutoring interaction is to shift responsibility for learning from the tutor to the student. In ideal interactions, the student should talk more than the tutor. The tutor's role is to elicit performance from the student, making it available for shaping. Through listening, prompting, clarifying, and reinforcing, the tutor shapes students' knowledge and skills. Thus, the tutor should use every opportunity to coach rather than tell.

Theoretical support for the ASK model comes from behavioral, cognitive, and sociocognitive literature. Research on microteaching, the Personalized System of Instruction (PSI), cooperative learning, reciprocal teaching, and feedback effects offers empirical support, particularly for the skill component of the ASK model. These studies identify many of the same tutor behaviors found in the ASK model, and they document the trainability of these skills. The majority of validation studies have been done on prompting and reinforcing, finding positive effects of these tutor behaviors on students' learning.

The ASK model and the research reviewed here suggest that knowledge development and skills training may be important determinants of effective tutoring interactions. Indeed, researchers have asserted that tutor training is an essential aspect of successful PSI courses, and some have offered evidence to support this assertion. Likewise, training has been successful in reciprocal peer tutoring.

Future research should explore just how much knowledge or expertise is needed for effective tutoring, and how this level varies across tutors. How do skills moderate the effectiveness of tutoring interactions? Given the potentially central role of tutor skills, research should also address different methods of tutor training.

Additional research questions concern the applicability of the ASK model across various disciplines, course levels, and types of knowledge. Would the model be equally effective for tutors in mathematics, child development, and art history? Would the model be equally effective for lower and upper level courses? In theory, the answers to both of these questions should be yes, because the ASK model represents a general process for shaping students' learning. Would the model be equally effective for tutoring students in declarative (content) and procedural (skills) knowledge? Probably, but the specific coaching techniques may vary. For example, verbal and written measures may be used for tutoring content knowledge, whereas observation and demonstration may be more appropriate for tutoring skills. In any case, these questions remain to be empirically demonstrated.

Contents

Introduction

As a training ground for life, college can be a peculiar experience. Students spend a great deal of time in the individual pursuit of knowledge and basic skills. After college, they spend the majority of their time working with other people to accomplish some particular goal. With planning and a little luck, they get to use some of the knowledge and skills acquired during college. Learning to work effectively with other people, however, is an ability rarely practiced in traditional college classrooms.

Scholars in a variety of disciplines have identified ways of reconceptualizing education to prepare students better for the transition from largely individual to collective activity. Many of these approaches advocate collaborative learning in a type of "cognitive apprenticeship" (Collins, Brown, & Newman, 1989) where faculty members serve as expert guides and students teach each other (Brown, Collins, & Duguid, 1989; Palincsar & Brown, 1984; Resnick, 1987). To maximize the instructional value of such an approach, a framework to prepare students for this new classroom role would be useful.

This paper proposes a model of tutoring for use in college classrooms. The peer tutor is conceptualized as a "coach" who guides and shapes students' learning. Three components of tutoring are discussed: (1) the tutor's *attitude* toward teaching, (2) tutoring *skills* such as listening, observing, prompting, questioning, clarifying, and providing feedback and reinforcement, and (3) the tutor's *knowledge* of the subject. Thus, it is called the ASK model of peer tutoring. Knowledge and attitude are boundary conditions, each requiring a threshold level for tutoring to be effective. The tutor's skills moderate the effectiveness of tutoring interactions.

The ASK model represents a synthesis of literature from three theoretical perspectives—behavioral, cognitive, and sociocognitive. The behavioral perspective is important because it has a rich history of implementing systems for training and evaluating tutors, particularly in the context of mastery-based systems of instruction (Keller, 1968). The cognitive perspective is important for its work in memory development (Brown, 1975), semantic elaboration (Craik & Lockhart, 1972; Craik & Tulving, 1975), metacognition (Brown, 1978), metamemory (Blake, 1973; Hart, 1967), verbalization (Gagne & Smith, 1962), and cognitive apprenticeships (Brown et al., 1989; Collins et al., 1989; Palincsar & Brown, 1984; Resnick, 1987). Finally, the sociocognitive perspective points out that learning occurs in a social context. Of relevance here is Vygotsky's (1978) work on the zone of proximal development and Rogoff's (1990) work on the shift in responsibility for learning from the teacher to the student through techniques such as guided participation and scaffolding. Theory and research from each perspective are offered to support the model and its components.

Whitman (1988) distinguishes between two types of peer teaching relationships: near-peer and co-peer. In near-peer relationships, one member is more advanced than the other, but still close enough in status to be considered a peer. In co-peer teaching relationships, students who are relatively equal with respect to their level of knowledge about the subject to be learned teach each other. This review focuses on near-peer tutoring relationships in college classrooms. An effort will be made to present research using adults; however, references regarding peer tutoring research with children will be offered where appropriate.

Behavioral Principles

For Skinner, the goal of education is to prepare students to act effectively in the absence of instructional contingencies (1968c, p. 86). Because teaching is "simply the arrangement of contingencies of reinforcement" (Skinner, 1968c, p. 5), preparing students involves teaching them how to arrange contingencies for themselves. Skinner asserts that education must be deliberately designed (1974), and that the principles of operant conditioning discovered through the experimental analysis of behavior should be applied to develop a technology of teaching (1968c, 1974).

A Technology of Teaching

What makes teaching effective? Skinner (1968c) challenges the popular metaphors of agriculture (cultivation, as in kindergarten), alchemy (infusion of ideas), and osmosis (absorption of knowledge) because they fail to specify what teaching is. Rather, teaching should shape and maintain behavior. It involves three essential components: (1) an occasion, (2) a behavior, and (3) its consequences (Skinner, 1968c). Teaching involves arranging contingencies between the student's behavior and reinforcing consequences. A familiar adage is that "we learn by doing." While Skinner (1968c, p. 5) agrees with this premise, he notes that merely doing something does not guarantee that it will be learned. He asserts that the action must be reinforced by some consequence.

In a common behavioral method, shaping, the teacher takes the student through a series of successive steps to learn a target, goal, or behavior. To induce the student to act, the teacher may use prompts. Prompts may require only a simple response (e.g., Is this an example of an independent or dependent variable?). Or, a prompt might ask the student to paraphrase a passage, a task that requires more effort and elaboration than a simple yes or no answer. To support the use of prompts that require more behavior on the part of the student, Skinner quotes Comenius: "The more the teacher teaches, the less the student learns" (1968c, p. 144).

This problem raises the issue of maintaining behavior. Ultimately, maintenance involves fading prompts until behavior comes under the control of self-generated stimuli (Skinner, 1968b). This is a subtle process by which prompts that require little behavior are replaced by prompts that require more elaborated responses. Progress from one step to the next is contingent on the students' performance. For example, a teacher might ask students first to read a section of text aloud, then to paraphrase it using the text as needed, and finally to close the text and explain it in their own words.

For Skinner (1968a), the problem was how to bring academic behavior under the control of relevant stimuli in the classroom so that it could be shaped and eventually maintained by the students' self-generated stimuli. To this end, he proposed programmed instruction and teaching machines as two ways to arrange instructional contingencies in the classroom. (1968a, 1968b, 1974).

Programmed Instruction and Teaching Machines

According to Skinner (1968a, 1968b), a major obstacle in traditional approaches to education is the meager schedule of reinforcement. To solve this problem, he suggested that teachers divide

the m _rial into very small units and arrange contingencies for reinforcing students' correct responses to each unit. To deliver reinforcement immediately, precisely, and in sufficient quantity, Skinner (1968a, 1968b) adapted Pressey's original teaching machine (cited in Skinner, 1968b).

The teaching machine is a vehicle for arranging and delivering instructional contingencies. Its success depends upon the quality of the programmed instruction designed to drive it. In contemporary terms, the teaching machine is the hardware and programmed instruction is the software. To program material, one must identify what students are to "know," divide the material into small steps, sequence and group the steps, and progress through the program contingent upon students' correct responses. Skinner asserts that programmed instruction is neither a Socratic method of asking leading questions nor can it be reduced to Comenius' contention that students should not be challenged beyond levels for which they are prepared. While these principles are incorporated in programmed instruction, they fail to specify the three critical components of a technology of teaching: the desired student behavior, its consequences, and the conditions under which it occurs (Skinner, 1968c, p. 61).

Skinner (1968b) observes that the machine has the advantages of a private tutor, but it arranges contingencies more precisely. The constant exchange between student and machine keeps students active. The program presents material in small steps, carefully sequenced, with prompts to help students answer questions for themselves. Finally, the machine reinforces every correct response.

While Skinner maintained that machines are superior to humans at arranging contingencies of reinforcement, it was Keller (1968, 1974) who demonstrated with the Personalized System of Instruction (PSI) that well-trained tutors could serve this function adequately.

The Personalized System of Instruction (PSI)

The central features of PSI are: (1) Course content is divided into small units, (2) students work through material at their own paces, (3) progress in the course is contingent upon mastery of units of material, and (4) proctors (peer tutors) provide students with feedback about their performance (Keller, 1974). A particular advantage of using tutors is "almost unavoidable tutoring, and a marked enhancement of the personal-social aspect of the educational process" (Keller. 1968, p. 83). Though Skinner observed that "verbal behavior always involves social reinforcemen." (1965, p. 299), he may have underestimated the social reinforcement offered by tutors as a source of motivation and encouragement for students.

Born (1970) argues that tutors lower student-to-teacher ratios and increase opportunities for individualized instruction. Though how much peers can teach has practical limits, given their limited expertise in the subject matter, upper-level students can still help lower-level student learn basic knowledge and skills. However, to be most effective, there is general agreement that tutors must be trained (Born, 1970; Conard & Semb, 1977; Keller, 1968).

The role of the tutors is to help evaluate students' learning and prescribe ways to improve it. Both tasks involve diagnosing students' problems with material and coaching them toward better understanding. Born (1970) describes explicitly how tutors should work with students. First, he instructs them to greet their students by name and to offer encouragement to alleviate anxiety that often accompanies testing. Second, they should respond to answers on students' exams, verbally

reinforcing those that are correct and prompting students to elaborate on those that are incorrect. If students do not give satisfactory responses, the tutor should not tell them the answer. Rather, the tutor should prompt students to say what they know about the topic. Finally, if this approach is unsuccessful, the tutor should recommend that students restudy the material. Throughout the interaction, students should do most of the talking. The tutor's role is to ask questions that elicit students' verbal descriptions of the topic so that these descriptions or representations can be shaped. Thus, as Born (1970) notes, tutors give students a greater "opportunity to respond" (Greenwood, Delquadri, & Hall, 1983).

Opportunity to Respond

Greenwood et al. (1983) have observed that children in traditional classrooms spend very little time actively engaged in academic behavior. Nearly half of their time is spent watching or listening to the teacher. Further, they noted that simply arranging contingencies for appropriate academic behavior does not improve performance, particularly among low-achieving students. Opportunities for engaging in academic behavior need to be considered as well. Thus, they have proposed the concept of opportunity to respond to analyze the interaction between the learning environment (antecedents) and student academic behavior (responses). Each side of this equation needs to be considered separately. Antecedents include instructional arrangements, strategies, and behaviors that set the occasion for high levels of academic responding. Responses are behaviors that demonstrate learning. Antecedents that create the greatest opportunities are those that elicit correct academic responses from the greatest number of students over the longest period of time. Thus, as Greenwood et al. (1983, p. 65) note, "opportunity is confirmed by the academic behavior produced."

Defined as "active" learning, opportunity to respond includes a variety of academic behaviors such as oral reading, writing, asking and answering questions, academic talk, and motor behaviors such as pointing or holding up flashcards. Such behaviors can be elicited by teachers, either with individual students or with small groups of students. However, this approach is generally limited in scope and efficiency.

Classwide peer tutoring is proposed as an alternative strategy to increase opportunity to respond (Delquadri, Greenwood, Whorton, Carta, & Hall, 1986). In this highly-structured exercise, students work in weekly-rotated teams and take turns serving as peer tutors for each other. Each student spends 10 minutes a day responding to questions or problems posed by a peer tutor. Tutors award points for correct responses. As tutors, students are trained to provide feedback to their partners about errors and how to award points. Teachers circulate about the classroom to observe teams. Tutors earn bonus points from teachers for effective tutoring behaviors such as immediate responding and cooperation with their partners.

Summary

Skinner (1968c) defined teaching as the arrangement of contingencies of reinforcement to shape and maintain students' academic behavior. The long-term goal of education is to bring such behavior under the control of students' self-generated stimuli. He recommended using programmed instruction and teaching machines, which he compared to private tutors, to accomplish this goal. Keller (1968, 1974) successfully implemented these procedures using tutors

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in the PSI. The functions of these tutors were clearly defined by Born (1970). Similarly, Delquadri, et al. (1986) and Greenwood, et al. (1983) have implemented classwide peer tutoring to increase low-achieving students' opportunity for academic responding.

Cognitive Processes

Learning involves memory. Operationally, learning is typically measured by one's remembering something so that it can be used in the future. Atkinson and Shiffrin (1968) distinguish between memory storage capacities (sensory, short-term, long-term) and memory control processes (selection, retrieval, rehearsal). Presumably, teaching helps learners encode information or skills, store them in long-term memory, and later select and retrieve them appropriately for future use. A variety of cognitive processes can facilitate this goal. Among these are organization of the material in some meaningful way and the use of semantic elaboration to extract essential meaning and identify connections with other concepts, ideas, and images. Knowledge about one's memory (metamemory), knowledge about problem solving (metacognition), and verbalization during learning also enhance memory. These processes have implications for both students and tutors.

Organization

In her comprehensive review of memory development, Brown (1975) shows that logically organized material is easier to recall than material that is arbitrarily sequenced. It appears that people rely on inferences and general knowledge to help them reconstruct such material. Moreover, compared with younger children, adults and older children remember material best when they have organized it themselves. Brown (1975) concludes that the relationship between age and self-organization is probably due to developmental differences in metamemory, discussed below.

Brown's (1975) review describes the benefits of organized material for the learner, but there are benefits for tutors, as well. In a study on the cognitive benefits of teaching, Bargh and Schul (1980) propose that teaching requires organization of the material to be taught. Tutors may try to commit to memory a series of isolated facts; however, this approach is rarely successful at ensuring the long-term storage and appropriate retrieval of information and concepts. Moreover, it makes explanation and clarification of the material for students potentially confusing: Where do you start?

Zajonc (1960) described how people organize information differently depending on their role in an interaction. In an experimental study, he demonstrated that people expecting to transmit information organize it differently than those expecting to receive it. After having read a letter from an individual applying for a job, transmitters' descriptions of the applicant were more differentiated, complex, unified, and organized than were receivers' descriptions. Subjects' descriptions of job applicants are interpreted as person schemas. Schemas are an individual's organized knowledge about people, places, or events. They function like prototypes to guide how we perceive, remember, and make inferences about information (Fiske & Taylor, 1984). Zajonc's (1960) interpretation of subjects' job applicant descriptions supports the assertion that one organizes knowledge differently if one expects to teach it.

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Repeated studies of short-term memory have demonstrated that people remember about seven bits of information at a time (Miller, 1956). This capacity can be expanded, however, if the bits are organized or chunked in some meaningful way. For example, recall is better for a series of letters that are grouped into familiar acronyms, such as FBI or RADAR, than for those that are not (Bower & Springston, 1970). Clearly, the extent to which chunks of information are meaningful depends on a person's knowledge base or expertise in the subject. This fact is elegantly demonstrated in Chi's (1978) studies of novice and expert chess players. The first study compared child chess experts with novice adults. Although adults outperformed children on recall of a number series, in chess recall, children correctly placed more chess pieces, required fewer trials to do so, and identified more and larger groupings of chess pieces than did adults. The second study compared adults of low, medium, and high chess knowledge as measured by the length of time taken to solve a typical chess puzzle. When chess pieces were arranged in patterns typical of the game, high-knowledge subjects correctly placed more pieces and required fewer trials than medium- and low-knowledge subjects. When chess pieces were arranged on the board in a random order, however, all three groups performed comparably.

Semantic Elaboration

Though short-term memory may be maintained by simply repeating it several times, this approach is insufficient for more complex material and for encoding something for storage in long-term memory. For this purpose, researchers agree that "depth" of processing through semantic elaboration is most effective (Craik & Lockhart, 1972; Craik & Tulving, 1975). Semantic elaboration involves embellishing material in a way that makes it meaningful, such as identifying a mnemonic, visualizing relationships among terms, or creating a sentence, story, or metaphor using the information. Actively constructing such connections facilitates storage of material in semantic memory, which Brown (1975) defines as "the organized knowledge a person possesses about words, meanings, relations, concepts, symbols, [and] rules" (p. 109). Questions that require inferences, generalizations, and applications of material are methods of measuring semantic memory (Brown, 1975). Such questions prompt students to explore connections among facts, terms, and concepts, and to relate these to what they already know. Thus, the complexity of material in the semantic memory system is directly related to one's overall knowledge base (Brown, 1975, Chi, 1978).

In a series of ten convergent studies, Craik and Tulving (1975) demonstrated the robustness of semantic elaboration to enhance memory. The first eight studies were tightly controlled laboratory projects; the last two were conducted in the classroom. All used the same basic paradigm with minor variations in the tasks. Prior to seeing a series of words, subjects were asked questions that would require them to focus on different aspects of the words they were about to see. At the shallowest level, questions involved a structural analysis (Is the word in capital letters?); the middle processing level involved a phonemic analysis (Does the word rhyme with weight?); the deepest level called for a semantic analysis (Is the word a type of fish? or Would the word fit in the following sentence: He met a _____ on the street?). Across all ten studies, answering questions related to the word's meaning (i.e., semantic processing) resulted in superior memory performance. This finding was maintained for both recognition and recall, intentional and incidental learning, and under laboratory and classroom conditions. Moreover, it was unrelated to length of time studying or rehearsing the stimulus, unrelated to the difficulty of orienting questions, and

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unaffected by incentives to remember words processed at shallower levels. Craik and Tulving (1975) concluded that "it is the qualitative nature of the (learning) task, the kind of operations carried out on the items, that determines retention" (p. 290).

Metacognition and Metamemory

A common goal for educational programs is to help students learn how to learn and how to define and solve problems. The term metacognition refers to our knowledge about knowing, learning, and problem solving. It involves "the active monitoring and consequent regulation and orchestration of [cognitive] processes in relation to the cognitive objects on which they bear, usually in the service of some concrete goal or objective" (Flavell, 1976, p. 232). Subsumed within this larger concept is Flavell's (1971) notion of metamemory, defined as knowledge about remembering. It includes awareness of memory capacity, strategies that enhance memory, and knowing that different memory tasks require different strategies.

Brown (1978) notes that metacognitive skills transfer across a range of problem-solving situations, both within and outside the classroom. Knowing what you know or do not know—for example, when you do not have enough information or cannot obtain needed information—is the first step in defining a problem. Additional skills involve prediction, planning, checking, and monitoring. Students need to be able to estimate the difficulty of tasks and the outcomes of various strategies, allocate sufficient time and resources for accomplishing tasks, and check to be certain solutions or results are logical and consistent with expectations. Wong's (1985) review of student self-questioning reveals that gains in reading comprehension are greater for students who generate questions during and after reading than for those who answer teachers' questions or simply re-read or summarize. The benefit of self-questioning also applies to comprehending lectures, as demonstrated by King (1989, 1990, 1992).

Different metacognitive approaches to learning emphasize different participants in the learning process. For example, Robinson's (1961) SQ3R method—survey, question, read, recite, and review—is designed for use by individual students. This metacognitive approach is designed to promote more effective reading comprehension. It is based on understanding that different types of reading material and different objectives for comprehension require different study approaches.

Collins' (1977) Socratic dialogues and Resnick's (1977) instructional conversations are teacher-directed approaches in which the teacher instructs students in inductive and deductive forms of reasoning and challenges them to reason for themselves. (Note: It is interesting that the term "instructional conversation" is also used by educational researchers following the recommendations of Tharp and Gallimore [1988, 1989]. However, no reference is made in this literature to Collins' [1977] theory of Socratic tutoring or Resnick's [1977] original use of the term.) Collins' method is based on the Meno dialogue of Plato (cited in Collins, 1977) and involves invoking a series of rules or prompts for eliciting discrete steps of logical reasoning from students. Many of these rules are metacognitive strategies for helping students diagnose what they know and do not know, and getting them to check and monitor the logical consistency of their arguments.

Palincsar and Brown's (1984) reciprocal teaching approach is a peer-directed strategy in which teacher and students take turns leading a discussion that involves using specific metacognitive strategies designed to enhance comprehension of a reading passage. The strategies are

summarizing (or self-review), questioning, clarifying, and predicting. The teacher models each of these strategies, and the students take turns practicing them while the teacher gives feedback. Two investigations of seventh grade remedial readers found that reciprocal teaching significantly improves reading comprehension (Palincsar & Brown, 1984; Palincsar, Brown, & Martin, 1987).

Metamemory, the "feeling of knowing" phenomenon, is a memory monitoring process. It involves surveying the content of one's memory. For example, Hart (1967) and Blake (1973) found that adult subjects' feeling of knowing positively predicted their correct recognition of word- and letter-trigrams that they were unable to recall. Confidence is related to this issue. Semb and Conard (1980) report a high positive correlation between college students' response confidence and the accuracy of their answers on a final exam.

Experimental research documents the use of additional memory monitoring and planning skills by college students. Johnson (1970) reported that units of short prose passages rated as important to the meaning of a story are recalled better than those rated less important. This finding was maintained across a series of three studies with different subjects, after immediate and delayed recall (up to 63 days), and under conditions that controlled the length of study time allotted to each unit, regardless of importance. Johnson concluded that college students categorize the importance of units as they encounter them, which implies evidence of a monitoring process. In the same vein, Masur, McIntyre, and Flavell (1973) found that third graders and college students were more likely than first graders to use additional study time for items previously missed on a recall test.

One objective of Chi's (1978) study with adult chess players, described earlier, was to test the effects of domain-specific knowledge on metamemory. High-knowledge subjects predicted that they would use fewer trials and recall more chess pieces when pieces were arranged in a coherent fashion than when they were arranged randomly. By contrast, subjects with little knowledge of chess did not differentiate between the two types of arrangements, predicting the same number of trials used and chess pieces recalled under both conditions. Chi (1978) concluded that, for adults, understanding about how to remember something is directly related to the level of one's knowledge in the domain.

Verbalization and Problem Solving

Piaget (1977a) observed that children often talk aloud while solving problems. What could be the function of such verbalization? Though there is some disagreement in the literature on the relationship between verbalization and problem solving, Gagne and Smith (1962) suggested that verbalizing may induce the problem-solver to generate alternative ways of solving the problem. They found that subjects who stated aloud their reasons for steps taken to solve practice problems similar to the Tower of Hanoi took less time and fewer steps to solve a posttest problem than those who did not talk aloud. Another reasonable explanation not discussed by the authors is the possibility that verbalization helped subjects control errors by reminding them about the rules of the problem. Finally, it should be pointed out that verbalization is one aspect of active responding noted by behavioral researchers (Keller, 1968; Skinner, 1968c).

Durling and Schick (1976) tested the relative contributions of verbalization and working with a partner to problem-solving. Verbalizing pairs and individuals teaching a confederate used fewer cards to solve three-attribute conjunctive problems than nonverbalizing subjects or those

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verbalizing to the experimenter. Verbalizing pairs also used more focusing strategies and monitored their errors better than the other conditions. The authors concluded that verbalizing to teach offers some particular advantages and recommended the use of peer tutors.

Summary

When students learn something with the intent of being tested on it, or using it in the future, the material is stored in long-term memory. The question is how to get to it. Performance problems may arise when students are unable to select and retrieve information on appropriate occasions. The cognitive processes discussed in this section pertain primarily to information encoding and retrieval. That is, organization, semantic elaboration, metacognitive and metamemory processes, and verbalization all serve to strengthen memory in various ways, thereby facilitating retrieval of information.

Sociocognitive Theories

The Social Context of Learning

Learning is largely a social activity. That is, it is often embedded in social interactions, initially with caregivers and siblings, later with peers. Vygotsky (1978) considers learning a "profoundly social process" (p. 131), but his notions extend beyond the idea that learning simply occurs in a social milieu. He asserts that the way individuals think and behave to solve problems is organizationally similar to the ways that groups solve problems. Initially, learning occurs between people (e.g., language) and becomes more individualized as these interactions are internalized. That is, the learner acquires greater control over responses in a domain. Thus, self-regulated learning is social in origin.

Rogoff (1990) follows Collins et al. (1989) in proposing the apprenticeship as a model for cognitive development because it emphasizes the social context of learning. In an apprenticeship, novices learn new skills by participating in problem solving with experts. The goal of an apprenticeship is to transfer responsibility for the activity to the novice. Guided participation by the expert is the process for accomplishing this goal. Rogoff suggests that the child is essentially a novice with respect to learning about the world, and certain adults, siblings, and peers are the expert guides.

Theory supporting the notion of a social context of learning is best represented by the work of Vygotsky (1978), Wertsch and Rogoff (Rogoff, 1990; Rogoff & Lave, 1984; Rogoff & Wertsch, 1984; Wertsch, 1979), and Bruner (1966) and his colleagues (Wood, Bruner, & Ross, 1976). Rogoff (1990) notes that, although much of this work focuses on child development, many of the ideas can be applied to adults as they encounter new learning contexts. The sections that follow discuss aspects of their theories that are relevant to tutoring.

Zone of Proximal Development (ZPD)

Vygotsky's (1978) view of the dialectical nature of human development is the basis for his assertion that development is not a static phenomenon. His method involved a variety of techniques such as introducing obstacles into a problem, giving a child "external aids" that permit multiple

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ways of solving problems, and presenting problems beyond the child's ability. In all of his investigations, he sought to understand the process children used to solve problems. In this way, he believed he could best study intellectual development as it unfolded.

The idea of a zone of proximal development (ZPD) is helpful for understanding tutoring. The ZPD defines the range of a child's ability, bounded at the lower end by the child's actual performance of a task unassisted, and at the upper end by the child's potential performance of a task under the guidance of someone more capable. The actual developmental level is retrospective, measuring the developmental feats already completed and processes already mastered. By contrast, the potential developmental level is prospective, measuring the processes as they are being formed. The ZPD defines the boundaries within which the child internalizes what he or she has just begun to learn during the course of interactions with others.

Wertsch (1984) notes that Vygotsky's zone of proximal development is not well defined, particularly the upper boundary of potential development. What did Vygotsky mean by "problem solving under adult guidance or in collaboration with more capable peers" (1978, p. 86)? To illustrate the confusion, he offers two different scenarios of adult-child interaction concerning a division problem, both of which lead to the same outcome. In the first example, the adult asks the child leading questions such as, "How many pairs of 2 are there in 13?" or "What do you do with the remainder?" In the second example, the adult tells the child to write numbers in certain places on a piece of paper. In both cases the potential level of development appears to be the same: The child eventually solves the problem under adult guidance. But the nature of guidance is quite different, and most would likely agree that the two children are not equally prepared to solve the division problem independently.

Wertsch (1984) proposes that this confusion can be clarified by focusing more on the process of guidance than on the outcome of children's behavior. He identifies three critical components of this process: (1) Both child's and adult's definitions of the task evolve and become more congruent with each other, though the child's definition generally undergoes a more radical change (situation definition); (2) these definitions are negotiated between adult and child at a level the child can understand (intersubjectivity); (3) the mechanism for negotiation involves coaching via questions or directives that require the child's understanding of the significance of alternative definitions and strategies. Wertsch suggests that an accurate definition of the zone of proximal development can be attained by examining the interaction of these three components.

The Role of Speech in Cognitive Development

Vygotsky (1978) asserted that cognitive development begins with the exercise of practical intelligence, a term that signifies adaptive behaviors that achieve a concrete goal, such as getting food. Social interaction in the form of speech plays a critical role in the development of practical intelligence. Piaget (1977a) observed that children often talk to themselves while solving problems even while another person is present, but he saw speech and problem solving as parallel activities and did not accord this "egocentric speech" any particular organizing or communicative functions. By contrast, Vygotsky contended that talking about something does not simply reflect what one is thinking about it, but serves to transform the way one thinks about it. Speaking about something helps one to organize one's thoughts about it, and different ways of organizing information can result in different ways of approaching a problem. Moreover, the process of social interaction

through speech with another offers the learner two further advantages: (1) One can add potential solutions by experiencing another person's way of organizing the activity or problem, and (2) one can receive feedback on his or her own organization.

Vygotsky observed that children frequently talk out loud to themselves while solving problems, and that the amount of this talk increased relative to the difficulty of the problem. For young children, this "egocentric" speech accompanies or follows actions, reflecting the process they are using to solve the problem. As they get older, speech gradually comes to precede action, guiding the child in solving the problem, thereby taking on a planning function. The symbolic function of language not only reflects aspects of a current situation, but also permits a conception of objects not present and future, hypothetical actions, not yet carried out.

At this point in development, the relation between speech and action. is transformed. It permits flexibility, planning, and mastery over one's own behavior. Speech, initially occurring between the child and adults for the purpose of emotional expression or communication (external speech) now occurs with oneself, first aloud (egocentric speech), and eventually silently to oneself (internal speech). Thus, Vygotsky proposed that egocentric speech is the bridge between external and internal speech. He notes that the development of language, from gesture to egocentric speech to (external) social speech to (internal) private speech parallels the same process as learning: Initially, language is used to communicate between the child and others, and, once internalized, it is used to organize thought and regulate oneself. It is in this sense that learning is a dynamic, socially elaborated process.

From Other- to Self-Regulation

Wertsch (1979) clarifies Vygotsky's (1978) assertion that the origins of cognitive development are found in social interaction. The argument rests on the notion that the development of individual cognitive capacities begins with guidance from another person, or "other-regulation," and moves through a series of transitions until children perform tasks independently; that is, until they have achieved "self-regulation." This is similar to Skinner's (1968c) goal of bringing students' academic responding under the control of self-generated stimuli and to the development of metacognitive strategies (Brown, 1978).

Speech plays a critical role in "self-regulation," in particular speech that is comprehensible to children. That is, it falls within their zone of proximal development. Wertsch illustrates how, in the context of learning, speech between children and others (social speech) leads children to talk aloud to themselves (egocentric speech) and eventually to "talk" to themselves privately (inner speech). Egocentric speech, having its roots in social speech, functions as the bridge between other-regulation and self-regulation. In other words, their cognitive behavior, initially under the control of verbal and nonverbal stimuli from others, comes under their own control.

The transition from social speech to inner speech does not occur instantaneously. Rather, it is a gradual process. For details about the steps in this process, see Wertsch (1979), who notes that Vygotsky's ideas about speech refer to the act of speaking, speech as verbal behavior, or the functional relationships between speaking and acting, not the acquisition of language systems or how children come to decode language. This aspect of his theory is often misunderstood.

Moreover, his notion about the zone of proximal development refers to how speech and other forms of guidance by more capable others function in the context of learning something new.

Adults' communication is not limited to directives children can readily understand. In fact, sometimes it is considerably more advanced, and children do not act on it. In general, however, adults tend to use directives that are beyond children's communicative ability and offer additional guidance, such as pointing. In this way, adults attempt to function within the child's zone of proximal development.

Intersubjectivity

According to Wertsch (1979), the primary mechanism that makes possible the transition from other- to self-regulation is intersubjectivity—children's striving to make sense of the definition of the situation and the connection between the adults' speech and their own actions. Moreover, this coherence is created after the fact. That is, they do not act because they share the adults' situation definition; rather, they come to share the adults' situation definition because they act and then adjust their own definition to be consistent with their behavior. Thus, Vygotsky emphasized the role of action in learning, just as did Skinner (1968c), Keller (1968), and Greenwood et al. (1983) in the behavioral literature.

Rogoff (1990) elaborates on the concept of intersubjectivity. For her, the term refers to the idea that the goal of a joint activity is negotiated by the people who participate in the activity. While an "external" goal may exist such as instructions for completing a task, the goal is interpreted and its meaning constructed by the individuals involved. Even when one person may be the expert, as is often the case with adult-child or tutor-tutee interactions, to participate in the activity, both members must define the goal. Novices in the relationship do not simply adopt the experts' goal definition, but must also make sense of the goal for themselves.

Communication about the activity, both verbal and nonverbal, is the vehicle for negotiating the goal. In this process, the experts help the novices understand the goal by making connections between what the novices already know and skills needed for the task. As such, the experts must diagnose what the novices are capable of at the present time and gauge what they might be ready to do or understand as a next step. Both experts and novices look for common reference points on which to build a shared definition. At the same time, the experts' definition of the situation must undergo modification to understand the position of the novices. At this point, communication in an expert-novice or adult-child situation is still likely to be asymmetrical, with the experts initially carrying most of the responsibility for the task. Rogoff notes circumstances of "natural diagnosing" where adults ask children to identify what they see in the task or activity.

Challenge and Support: The Role of More Capable Others

Rogoff (1990) uses the terms challenge and support to describe the functions of adults in joint activity with children. She suggests adults support children's learning by structuring the activity through asking appropriate questions. The questions may break the task into more manageable subgoals, by first asking children to identify parts of the task and then asking what comes next. Appropriate questions help children organize the task and maintain involvement at the level of which they are capable. When the children do not respond initially, it is more helpful to rephrase

and elaborate than simply repeat questions. One way to question appropriately requires that the adults know when to ask questions that provide children with hints that help them accomplish the task, and when not to offer assistance. Guided participation and scaffolding are terms used to describe the process of balancing challenge and support. They are analogous to the behavioral principles of shaping and fading (Skinner, 1968c) and may help children encode semantic or procedural knowledge in more meaningful ways (Craik & Lockhart, 1972; Craik & Tulving, 1975).

Rogoff (1990) introduces the concept of guided participation to describe how children learn. Guidance can range from explicit instructions to subtle hints; participation refers to shared responsibility for the activity. The process involves children and more competent others such as parents, caregivers, siblings, and peers working together in ways that build on what children already know and challenge them to develop new knowledge and skills.

Scaffolding is an interactive process by which learners come to perform a task beyond their initial ability. Similar to a private tutor (Skinner, 1968b), the teacher directs the learners' attention, breaks the problem into manageable components, and provides corrective feedback as needed. The term comes from observations of tutor-child interactions during a block construction task (Wood, Bruner et al., 1976). The role of the tutors varies with the age and the ability of the children: For 3-year-olds, she recruited attention to the task; for 4-year-olds, she coached verbally; for 5-year-olds, she gave encouragement, feedback, and reinforcement for their constructions.

To be effective, tutoring involves contingent instruction (Bruner, 1966; Wood et al., 1978). Similar to shaping (Skinner, 1968c), assistance is systematically adjusted depending on the success or failure of the learners at each step of the process. Effective teachers constantly compare the task goal with their (1) diagnosis of the learner's ability, and (2) judgments about the type and extent of coaching required. Effective teachers then aim the level of assistance slightly beyond the children's current level of success, using the following rule to adjust the level of assistance: "If the child succeeds, when next intervening offer less help. If the child fails, when next intervening take over more control" (Wood et al., 1978, p. 133). Thus, the teachers' scaffold, having supported the children through initial phases of the task, must eventually be removed one piece at a time to enable the children to problem solve independently. This process is analogous to fading prompts (Skinner 1968c) discussed earlier in the section on behavioral principles.

A critical aspect of contingent instruction is that learners recognize a solution before they can produce it without assistance. This notion follows McNeil's theory (cited in Wood et al., 1978) about the recognition-production gap in linguistic comprehension; it underscores the importance of teaching within the learners' "region of sensitivity to instruction" (p. 133) where they are more likely to recognize the significance of the teacher's prompts. Moreover, it emphasizes the relationship between language and actions shared by tutor and learner. Whereas learners may be able to understand the tutor's verbal instructions in the context of the task, they may fail to complete it by themselves if they have not shared enough of the actions involved in solving the task.

Rogoff notes that a goal for learning is the eventual transfer of responsibility for managing the activity from adult to child, or from expert to novice. Such transfer is a dynamic process wherein the adult or expert is constantly measuring the child's changing competence against the task requirements and adjusting the support accordingly. She cites Wood and Middleton's (1975)

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concept of the "region of sensitivity to instruction"—analogous to Vygotsky's zone of proximal development—in which a tutor challenges a tutee at one level beyond the currently functioning level. This involves some problem solving on the part of the tutor: "Wood and Middleton (1975) point out that effective tutoring involves problem solving for the tutor, in terms of how to modify the approach on the basis of how the tutee responds to instruction" (p. 100).

Summary

Both in school and out, learning occurs in a social context. Speech, at first external and eventually internal, plays a critical role in self-regulated learning. The most effective instruction is conducted within students' zone of proximal development: It challenges students to reach their potential level of development, and supports them through scaffolding and guided participation that is contingent upon their current performance. The eventual goal of instruction is to shift responsibility for learning from teacher to student.

The ASK Model of Peer Tutoring

We view tutors as coaches. They facilitate learning by eliciting active participation from their students (Collins et al., 1989; Rogoff, 1990; Skinner, 1968c). They guide students through the learning process by balancing appropriate challenge with contingent support. Gauging the optimal balance of challenge and support requires some qualifications; namely, knowledge, a positive attitude, and good communication skills. A tutor's knowledge and attitude are boundary conditions. They are necessary, but not sufficient, for promoting optimal learning. Skills in communicating moderate the effectiveness of the tutoring interaction. At a minimum, tutors should know more about the subject than students and must want to teach. Beyond this, additional increments in knowledge or attitude by themselves will not materially affect the quality of the interaction. Rather, skills determine the degree to which attitude and knowledge contribute to effective tutoring. As such, these three components comprise the ASK model of tutoring. It is adapted from Feisel's (1985) conceptualization of a comprehensive educational program.

Attitude

Approachability is the hallmark of a positive attitude toward tutoring. This quality is generally characterized by friendliness and a desire to help others learn. The approachable tutor knows and uses students' names, offers encouragement, invites questions, and shows empathy.

While few would question the assertion that a positive attitude contributes to effective tutoring, many would disagree about the source of such an attitude; e.g., Good teachers are born, not made. Others would argue that a positive attitude toward tutoring can be trained. Our position is somewhere between these two extremes. At the lowest threshold, tutors must prefer teaching to not teaching. Beyond this, a positive attitude can be cultivated by training.

Skills

To be effective, tutors require good communication skills. They must listen to and observe their students, and prompt them in ways that occasion students' active participation. Furthermore, they

must clarify misconceptions, provide feedback, and reinforce good performance. Essentially, an effective tutor "coaches" students in how to learn material for themselves.

Good communication skills begin with attentive listening. But how do students know if tutors are listening to them? Tutors make eye contact. They nod and say "uh-huh" or "OK" at intervals while students speak. They paraphrase what students say; for instance, so you're confused about the difference between punishment and negative reinforcement? They observe nonverbal signs of uncertainty or confusion, particularly if such behavior contradicts the students' spoken message. Attentive listening requires focusing attention on the speaker rather than on oneself.

Early in the interaction, tutors must identify problems by finding out what students know and do not know about the material. They may do this by asking students to explain a concept or to justify a response. If students seem to be having problems with the material, tutors may ask them how they study. The goal of asking questions and listening is to diagnose students' current knowledge. It may also be used near the end of an interaction to check students' understanding of the material just covered.

Once a problem is defined, tutors need to prompt students to perform. Questions that require elaborated responses will be most effective. Tutors may ask students to break the material into components, give an example, evaluate answers on an exam, repeat or explain something in their own words, or rephrase a question. Even less challenging ways of prompting may be helpful, such as having students read exam questions aloud or directing them to review a particular concept. Regardless of the specific technique used, prompting should always occasion student participation.

During or after prompting, tutors may need to clarify or correct students' misconceptions about the material. This is usually offered as a brief explanation and may be accompanied by examples. Tutors may also suggest ways to help students think about concepts, rephrase material, offer study tips, or read exam questions aloud. While clarifying, tutors typically talk more than the students. However, this approach should be used only after attempts to prompt students to perform have failed. A common mistake made by inexperienced tutors is to lecture at students before they have listened and prompted appropriately.

Throughout the interaction, tutors need to reinforce good performance. Usually, this involves a positive evaluation of the accuracy or quality of students' responses. It may also be more subtle, such as smiling or nodding while students are talking. Ideally, this feedback will be more positive than negative. It should be pointed out that reinforcement and feedback are frequently delivered concurrently. Knowledge of results and reinforcement represent different aspects of the process and, from a theoretical perspective, they deserve to be separated. However, from a practical standpoint, separating them is difficult to do. To be most effective, tutors should provide both knowledge of results and reinforcement.

Knowledge

Finally, tutors must know quite a bit about the domain of study. Without an adequate knowledge base, they may be unable to diagnose the students' current level of knowledge or to formulate appropriate questions that prompt student involvement in the learning process.

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Furthermore, a competent knowledge base is necessary to clarify misconceptions and to recognize when to reinforce accurate responses.

Theoretical and Empirical Support for the ASK Model

The next section reviews theoretical and empirical support for the ASK model of peer tutoring. Considered first is support for the model as a whole. Similar educational approaches are discussed and support is offered for the relationships among the components of the model. Next, the components are considered individually, with the primary focus on tutoring skills. The majority of the empirical research comes from tutor training studies.

The ASK model views the tutor as a coach who guides and shapes student learning. Other educational approaches that define a tutor's role in this way are the (1) cognitive apprenticeship model, in which "teachers promote learning, first by . . . modeling their strategies for students in authentic activity . . . support(ing) students' attempts at doing the task . . . finally, they empower the student to continue independently" (Brown et al., 1989, p. 39); (2) reciprocal teaching, in which teacher and student are mutually responsible for student's learning through the "continuous evaluation and revision in the teacher's theory of the student's competence, a theory that must be responsive to the level of participation of which the student is currently capable" (Palincsar & Brown, 1984, p. 169); and (3) PSI tutor training, in which tutors are taught the basic components of the ASK model (Born, 1970).

Relationships Among Components

What evidence exists to support the contention that knowledge and attitude must be present in some minimal degree, and that skills moderate the effectiveness of interactions? As mentioned earlier, the ASK model is based, in part, on Feisel's (1985) conceptualization of a comprehensive educational program. Feisel proposes using three types of objectives to design courses and curricula: (1) principles or content to be learned, (2) skills to apply the principles, and (3) a positive attitude toward learning and the subject matter. The ASK model adapts Feisel's (1985) definitions and applies them to the qualifications and training of tutors.

One of the parameters of the ASK model is that the tutor's knowledge is necessary, but insufficient by itself, for effective tutoring. This is similar to Simpson's (1991) eloquent discussion of substance versus style in college teaching. Describing issues involved in programming material for instruction, Skinner (1968c) notes that knowledge of a field is not sufficient to design effective programs: "Experts are not necessarily good teachers, and they are not necessarily good programmers" (p. 224). To the extent that Skinner (1968b, p.39) compares programmed instruction implemented by teaching machines to skillful tutors, his assertion offers theoretical support for the notion that knowledge alone is insufficient and that skills moderate the effectiveness of tutoring.

Empirical evidence to support the contention that knowledge and attitude define boundary conditions for tutoring comes from research on PSI tutors' accuracy in grading exams. Two studies conducted by Sulzer-Azaroff, Johnson, Dean, and Freyman (1977) found positive relationships between quiz-scoring accuracy on exam questions and student performance. When grading quizzes, tutors marked students' answers as "correct," "unclear," or "incorrect." For answers

marked "unclear," the student had an opportunity to earn the points for the question by explaining the right answer. If the oral explanation was judged to be satisfactory, the student also wrote out the answer. When incorrect quiz items were accurately scored, 63% of the parallel items on the final exam were answered correctly. By contrast, when incorrect quiz items were inaccurately scored, only 21% of the parallel items on the final were answered correctly. Accurately scored correct quiz items resulted in 91% of the parallel items being answered correctly. This same pattern of results was replicated for the second study, which also included an accuracy training program.

Why would tutors score students' exams inaccurately? The authors suggested that tutors exercised too much leniency with students. Another factor could be insufficient knowledge of the topics covered by the questions. In either case, to the extent that quiz-scoring accuracy reflects knowledge of the subject and/or a lenient attitude toward students' learning, the data suggest that limitations in these components can negatively influence student learning.

Attitude

Support for the role attitude plays in tutoring comes from Beach (1974). Videotaped observations of students working in small self-directed groups indicated that ineffective communication skills and a lack of understanding interfered with learning. McKnight (1972) identified teacher responsiveness, which he defined as a combination of active listening and appropriate responding, as an important component of the ASK model. Appropriate responding involves teacher concern for reciprocity in the classroom and being sensitive to students' verbal and nonverbal feedback concerning their learning. It includes teacher responses such as encouragement and follow-up of ideas, raising substantive questions that may have a range of acceptable answers, positive affect, and encouraging students to ask questions. Responsiveness (McKnight, 1972) increases the student's opportunity to understand the concepts being discussed, which is similar to the concept of "opportunity to respond" introduced by Greenwood et al. (1983).

A positive attitude toward teaching also appears to be important. Conard and Semb (1977) found that students who applied to be tutors in a PSI course were generally friendly, helpful, and approachable as measured by ratings of applicants' responses during a role-play selection process. They concluded that the majority of applicants came to the tutoring experience with good social skills, but that deficiencies displayed by some applicants could be remedied with training. Indeed, friendliness and social skills are frequently listed as criteria for selecting tutors, and there is general agreement with Conard and Semb (1977) that students who apply to be tutors already possess a good social repertoire (Johnson, 1977; Robin, 1977).

Skills

Assessment, Training, and Evaluation

The ASK model identifies fundamental tutoring skills that can enhance student learning. These skills are part of a three step process—*assessment, training,* and *evaluation*—(Semb, Ellis, Matheson, & Parchman, 1992).

The first step in the process, assessment, involves listening and questioning the students to demonstrate what they do and do not know. The tutor then determines the discrepancy between

what the student knows and what defines a competent or satisfactory level of performance. Because students have differing levels of knowledge, it is important to determine what they know and what they don't know before tutoring begins. For example, the tutor might ask, "How is X related to Y?" If the student can explain the task or concept, the need for tutoring ends. However, if the explanation is incorrect or incomplete, the tutor must move to the next step and select an appropriate intervention strategy. Another important outcome of assessment is a shift in the focus of instruction from the tutor to the student. Giving the student the chance to verbalize knowledge and demonstrate skills serves not only as an assessment tool for the tutor, but also as practice for the student. Finally, it communicates to the student a sense of interest on the part of the tutor.

During the second step, training, the tutor determines what needs to be done to bring the student to a desired level of performance. That is, once the baseline measure of performance has been established, the tutor determines the desired level and the procedures by which he or she will attempt to effect that goal. This may include tutoring techniques such as modeling, prompting, Socratic questioning, and providing examples and non-examples, and demonstrations.

Once the problem is assessed and training begins, it becomes a continuous, iterative process. The tutor is not only a source of knowledge or skills but also the evaluator of the student's acquisition of that knowledge or those skills. The tutor repeats the steps as necessary until the student reaches criterion or the session ends. As Palincsar and Brown (1984) point out, there is a "continuous evaluation and revision in the teacher's theory of the student's competence, a theory that must be responsive to the level of participation of which the student is currently capable" (p. 169).

Feedback and reinforcement are important aspects of evaluation, as both can dramatically affect learning. Feedback is the knowledge of results the tutor provides the student about his or her performance. Just as important as knowledge of results, however, is how it is delivered. This relates to issues of reinforcement and punishment. One type of reinforcement, praise, is a particularly powerful and easy to use way of letting students know when they've done a good job (Keller, 1968). To be most effective, praise should be directed at those aspects of performance the tutor liked and not the person. For example, "Emily, you're a great girl," will not be as effective as "Emily, only Houdini could have figured out a solution to that equation faster than you did." Praise about the person can frequently be misinterpreted by both the recipient and others. Finally, good tutors avoid tactics such as criticism, cynicism, ridicule, sarcasm, and degradation.

The three-step process of tutoring maps on to the ASK model as follows. Listening and questioning are tutor behaviors involved in assessment. Training refers to the specific tutoring interactions that occur between student and tutor after assessment is completed. Feedback and reinforcement are things tutors do as part of the evaluation process. The three-step process is just that—a process of tutoring. ASK is a model of how components of this complex processes are related to one another.

Skinner (1968c) offers support for the ASK model of tutoring. Through listening and questioning, the tutor arranges contingencies for students to describe what they do and do not know, and to shape their understanding. Corrective feedback clarifies material that is misunderstood. Prompting, shaping, and fading are also important. Finally, reinforcement of accurate responses may strengthen students' comprehension of the material.

The cognitive literature on semantic processing (Craik & Lockhart, 1972; Craik & Tulving, 1975), metacognitive strategies (Brown, 1975, 1978), and the benefits of verbalization to problem solving (Durling & Schick, 1976; Gagne & Smith, 1962) suggests that tutors can help students organize and elaborate material by building a framework for remembering it, relating it to other information and concepts. Tutors can arrange contingencies for students' verbal elaboration of content and skills, and provide corrective feedback and reinforcement on performance. While these tasks could be accomplished through written papers or individual instructor-student meetings, trained tutors offer the particular advantages of frequent verbal rehearsal and individual feedback.

Questioning and prompting require students to reconstruct what they have studied. According to the cognitive literature, students remember material better and in a way that makes it more useful in the future, if they "construct" it, or at least reconstruct it, for themselves by explaining or writing about it in their own words or using it (Brown, 1975, 1978; Glaser & Bassok, 1989; Piaget, 1977b; Vygotsky, 1978). This is a challenging task. It requires concentration and effort, and involves more risk than simply "exposing" oneself to the material by reading a chapter or memorizing information for an exam. Tutors who are experts in the subject relative to their students may be compelled to provide "short cuts" by explaining material to the students. However, there is evidence that optimal encoding, selection, and retrieval occur when students actively reconstruct the knowledge base themselves (Brown, 1975; Palincsar & Brown, 1984).

In the sociocognitive literature, Vygotsky's (1978) zone of proximal development (ZPD) and Bruner's concept of scaffolding (Wood et al., 1976) offer support for the ASK model. The tutoring interaction should take place within the student's ZPD for the material to be learned. Questioning and listening can be used to ascertain the lower boundary of the ZPD. Prompting until the student demonstrates understanding of the material without aid from the tutor determines the upper boundary of the ZPD.

Likewise, a series of prompts provides a scaffold (Wood et al., 1976) upon which students can build their understanding. Listening and prompting provide the basis for the scaffold's foundation. While each level of the scaffold offers a new challenge, it is supported by what the student has demonstrated at the previous level. Finally, the tutor must "dismantle" the scaffold when the student has demonstrated, by mastery of the material, that it is no longer required.

Considerable theoretical support comes from the teacher training literature on microteaching (Allen & Ryan, 1969; McKnight, 1979). Several of the "technical skills of teaching" overlap with the ASK model. Using silence and interpreting nonverbal cues from students that signal their understanding are critical aspects of active listening. Generating examples to illustrate concepts is a tutoring skill, and reinforcing participation is an important part of the evaluation process. Probing questions, a primary tool for listening and prompting may occasion student involvement because they ask the students to go beyond a surface understanding of the material. McKnight (1974) notes that students can be trained to ask such questions of each other and that benefits may be accrued by both asking and answering questions. Emphasizing the interdependent, dynamic nature of learning, he advocates a more active role for students by soliciting their participation in developing educational activities and training them in the rationale and use of probing questions. Fostering mutual involvement might help teachers and students "develop a diagnostic approach to classroom instruction" (McKnight, 1974, p. 8). McKnight (1971, 1979) has called for studies to validate the technical skills by examining their effects on student outcomes.

McIntyre, McKnight, and White (1977) offer extensive operational definitions for checking students' understanding, higher order questioning and probing, explaining clearly, and using examples. Specifically, probing questions should seek justification, elaboration, and clarification of the students' answers. Clear explanations use visual techniques whenever possible, avoid inappropriate vocabulary and vague terms, and refer to previously covered relevant topics. Use of examples includes both those offered by the teacher and those solicited from students to modify and extend students' comprehension of the material.

The PSI literature has identified many of the same skills as theoretically important for student learning. Most of these studies have compared tutors' use of these skills before and after training, but have not examined their effects on student performance. Lazar, Soares, Goncz, and Terman (1977) describe a program for training tutors to assess a student's prior (baseline) knowledge about a particular topic by asking questions or having the student analyze examples or graphs and reinforce accurate responses. They outline what should happen during tutor-student interactions, but offer no data to describe what actually does happen.

Johnson (1977) described a task analysis of tutor behavior that included some of the ASK model and documented the extent to which these skills were part of tutors' repertoire prior to training. Praising and listening were listed as appropriate social behaviors. Eye contact, nodding, orienting one's body toward students, and verbally acknowledging students' statements were tutor behaviors that demonstrated listening. Johnson noted that most tutors began the experience with an adequate social repertoire. He observed that tutors tended to offer too much information and did not ask students enough questions during quiz-scoring. He suggested that "appropriate prompting was not a natural characteristic of tutor repertoires" (Johnson, 1977, p. 234), but can be trained and maintained. Data to support his assertion will be discussed below (Johnson & Sulzer-Azaroff, 1978).

In the same vein, Kozma, Kulik, and Smith (1977) demonstrated that many skills in the ASK model can be trained. They field tested a written guide designed to train specific tutoring and evaluation skills (attending, praising, asking questions, clarifying study procedures, eliciting student participation) and discourage tutor behaviors deemed counterproductive to students' learning (lecturing and criticizing). Attending corresponds to listening, and praise and encouragement correspond to reinforcement. Asking questions "stimulate(s) students to express what they know and give(s) them opportunities to learn and remember the material better" (Kozma et al., 1977, p. 224). As such, the definition includes both assessment and training.

Compared with untrained tutors and those trained with an earlier version of the guide, tutors trained with a revised version of the guide (including units devoted to application and feedback on target skills) demonstrated increases in all skill areas except praising, and decreases in lecturing and criticism. Moreover, tutors trained with the revised guide lectured at students about one-third as often as untrained tutors. Unfortunately, Kozma and colleagues (1977) also did not evaluate the effects of training on student performance.

Robin and Heselton (1977) added a direct skill-training component to a written manual and tested the effects of this training on student performance. They focused on tutors' social behavior, feedback, praise, and prompting. As defined here, social behavior overlaps with attitudes in the ASK model. The definition of prompting was identical to that in the ASK model. Prompts were

discriminated as either general or specific. Classroom observations of tutors revealed that direct skill training using audiotaped models and role plays in addition to a manual increased praise, but did not influence social behavior or feedback more than the use of a manual alone. The majority of tutors did not increase prompting after either type of training. Moreover, type of training had no significant effect on student performance as measured by scores on the first midterm exam, which comprised 12 short-essay questions. It should be noted, however, that these effects were tested after a summer had elapsed between tutor training and measurement of student performance.

Effects on Student Performance

Tutor skills appear to promote better student learning. Empirical support for this assertion comes from a PSI study with college students (Johnson & Sulzer-Azaroff, 1978), research on small group interaction with elementary and junior high students (Webb, 1991), and reciprocal peer tutoring studies on reading comprehension in junior high students (Palincsar & Brown, 1984). Also relevant is a meta-analysis of the effects of feedback in written and computer-based instruction (Bangert-Drowns, Kulik, Kulik, & Morgan, 1991).

Using a multiple-baseline design, Johnson and Sulzer-Azaroff (1978) examined the effects of training nine tutors to use general rather than content-specific prompts during quiz evaluation on (1) tutors' quiz evaluation behaviors, and (2) students' recall and generalization of content. General prompts were those that contained no information beyond what was offered in the quiz item, asked the student to justify an answer, provided novel examples, defined terms, or restated an answer. Content-specific prompts included information not contained in the quiz item, perhaps from the text, study guide, or other quiz items. Training included written materials plus reviewing and evaluating videotaped tutor role plays. Tutors were videotaped while role playing typical interactions with students, and the videotapes were reviewed and evaluated. Tutors in the videotapes were asked first to identify things they did well and things they would do differently. Other tutors were asked to contribute their feedback next, and the trainer offered her feedback last. Training increased tutors' use of general prompts during quiz evaluation, from 50% prior to training to more than 90% after training. General prompts were more effective than content-specific prompts during quiz-evaluation as measured by students' scores on parallel retention and generalization items answered four weeks later. However, this was true only for students who demonstrated mastery on the original unit quiz. The differential effects of general versus content-specific prompts were not found for students who failed the original unit quiz, probably because they studied during the interval between taking the quiz and answering the retention and generalization items.

The next set of data comes from studies of small group interaction and learning. These arrangements typically involve cooperative learning, where students are instructed to teach each other. In this sense, they differ from the near-peer tutoring arrangements that are the focus of this review. Nevertheless, they offer support for the types of responses typically elicited by questions that prompt students to become involved in the learning process.

King (1989, 1990) used modeling, written exercises, and modified role plays to train college students to ask each other questions beyond mere recall, questions that required critical thinking skills such as application, analysis, synthesis, and evaluation. This is analogous to prompting (Skinner, 1968c). Following a 90-minute lecture and 10 minutes of cooperative work in small

groups, trained students performed better than untrained students on tests of lecture comprehension.

Webb (1991) reviewed studies on the effects of small group interaction in elementary, junior, and senior high school students' mathematics achievement. She used stringent criteria to select studies included in the review. They had to have measured individual student behavior and performance, not just the behavior of the group. They all used basically the same cooperative learning procedure, whereby students were instructed to help each other work on a set of problems together, not divide the work between them, and consult each other when they had questions before asking the teacher. Webb's analysis of 17 studies revealed that giving elaborated explanations was positively related to achievement, and receiving nonresponsive feedback (e.g., receiving only the correct answer, but no explanation) was negatively related to achievement. Webb's (1991) results support the use of these tutoring skills.

In the same vein, Palincsar and Brown's (1984) research on reciprocal teaching in reading comprehension supports listening and prompting as important assessment skills. They tested the effects on reading comprehension of practice in summarizing, formulating questions, and making predictions about a reading passage while serving as a teacher for another student. For 24 seventh-grade poor readers, they compared reciprocal teaching with a traditional method for teaching reading comprehension (locating information in the text to answer questions) and two control groups. One control group took all of the daily assessments, but received no instruction, and the other completed the pre- and post-tests only. The reciprocal teaching group met in pairs with an adult, who modeled the comprehension strategies identified above. The students took turns in the role of teacher for each other, and the adult shaped their practice of the comprehension skills, using contingent reinforcement and fading prompts, as needed. The 20-day experiment was a multiple-baseline design. For three groups, comprehension was assessed daily using a ten-item quiz. Maintenance of comprehension was measured five days after training and again after eight weeks.

The reciprocal teaching group scored higher than the other three groups on the daily assessments, and this superiority was maintained. They scored higher than a control group on a measure of generalization to reading in science and social studies. Four of the six reciprocal teaching students also gained an average of 15 months on a standardized reading test. Again, to the extent that summarizing and generating questions are the types of responses elicited by questions that prompt active participation, Palincsar and Brown's (1984) results support the use of these skills in tutoring interactions.

Evidence to support the skills of clarifying and reinforcing is found in a review of research on the instructional effects of feedback (Bangert-Drowns et al., 1991). In the ASK model both clarifying and reinforcing are types of feedback. Clarifying is offered for students' incorrect responses and involves correcting or explaining. By contrast, reinforcing is offered for students' correct responses and involves praise or encouragement. Bangert-Drowns et al. (1991) conducted a meta-analysis of 40 studies on feedback effects in written and computer-based instruction. The majority of subjects were college students. Two variables related to the effects of feedback are relevant to the skills of clarifying and reinforcing in the ASK model. First, feedback was less effective if students had access to correct answers prior to generating their own. Second, feedback that simply informed students if an answer was right or wrong was less effective than elaborated

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feedback. This second finding was particularly true for errors. That is, if students answered items incorrectly during instruction and received feedback, they were more likely to answer them correctly in a subsequent test than if they had received no feedback during instruction. By contrast, if they answered items correctly during instruction, there were no differences in the effects of receiving or not receiving feedback. The authors concluded that feedback was most effective when it "informed students of correct answers, after they had formulated their own responses" (Bangert-Drowns et al., 1991, p. 232).

Knowledge

In most situations, tutors know more about the subject and know it better than their students. In cognitive science terms, their knowledge is organized more as that of an expert is. To be effective, tutors must know enough about the subject to be able to pose appropriate questions and to judge the accuracy of, and errors in, the students' responses.

These assertions are consistent with Vygotsky's (1978) view that optimal learning is an outcome of interactions with adults or more capable peers. Skinner (1968b) conceived of programmed instruction for the teaching machine as an omniscient tutor with respect to the particular knowledge domain. Indeed, Johnson (1977) and Conard and Semb (1977) note that a solid base of knowledge is often a criterion for selecting tutors in PSI courses.

The level of a tutor's knowledge appears to affect student learning. PSI studies on the relationship between tutors' quiz-scoring accuracy and students' course performance are relevant here (Sulzer-Azaroff et al., 1977). To the extent that tutors sometimes score student answers right when they are actually wrong, tutors may reinforce students' inaccurate conceptions of the material.

A study by Webb and Kenderski (1984) supports the hypothesis in the ASK model that the tutor's knowledge serves as a boundary condition for students' learning. Examining small group interaction and learning, they found no significant relationship between receiving explanations and mathematics achievement. They discussed their results in the context of other studies that had found a positive relationship between these variables, and concluded that effects of tutoring on achievement depended on receiving explanations from students who were above average in ability. Their analysis offers support for the notion that students' learning can be limited by the tutor's knowledge.

Conclusions

The ASK model defines three components of effective peer tutoring: a positive *attitude* toward teaching, tutoring *skills* (listening, observing, prompting, clarifying, providing feedback, and reinforcing), and tutor's *knowledge* of the subject. It is hypothesized that knowledge and attitude are boundary conditions, requiring a threshold level for tutoring to be effective, and that skills moderate the effects of knowledge and attitude in tutoring interactions. The tutor is conceptualized as a "coach" who guides and shapes students' learning.

The goal of an effective tutoring interaction is to shift responsibility for learning from the tutor to the student. In ideal interactions, the student should talk more than the tutor. The tutor's role is to elicit performance from the student, making it available for shaping. Through listening, prompting, clarifying, and reinforcing, the tutor shapes students' knowledge and skills. Thus, the tutor should use every opportunity to coach rather than tell.

Theoretical support for the ASK model comes from behavioral, cognitive, and sociocognitive literature. Skinner's (1968c) definition of teaching as the arrangement of contingencies of reinforcement and Vygotsky's (1978) concept of teaching within the students' zone of proximal development are particularly useful. Research on metacognitive and metamemorial processes (Brown, 1975, 1978) and semantic elaboration (Craik & Lockhart, 1972; Craik & Tulving, 1975) are also relevant.

Research on microteaching, PSI, cooperative learning, reciprocal teaching, and feedback effects offers empirical support, particularly for the skill component of the ASK model. These studies identify many of the same tutor behaviors found in the ASK model, and they document the trainability of these skills. The majority of validation studies have been done on prompting and reinforcing, finding positive effects of these tutor behaviors on students' learning.

The ASK model and the research reviewed here suggest that knowledge development and skills training may be important determinants of effective tutoring interactions. Indeed, researchers have asserted that tutor training is an essential aspect of successful PSI courses (Johnson, 1977; Kozma et al., 1977; Lazar et al., 1977; Robin, 1977; Robin & Heselton, 1977; Weaver & Miller, 1975), and some have offered evidence to support this assertion (Johnson & Sulzer-Azaroff, 1978). Likewise, training has been successful in reciprocal peer tutoring (King, 1989, 1990; Palincsar & Brown, 1984).

Future Efforts

Future research should explore just how much knowledge or expertise is needed for effective tutoring, and how this level varies across tutors. How do skills moderate the effectiveness of tutoring interactions? Given the potentially central role of tutor skills, research should also address different methods of tutor training.

Additional research questions concern the applicability of the ASK model across various disciplines, course levels, and types of knowledge. Would the model be equally effective for tutors in mathematics, child development, and art history? Would the model be equally effective for lower- and upper-level courses? In theory, the answer to both of these questions should be *yes*, because the ASK model represents a general process for shaping students' learning. Would the model be equally effective for tutoring students in declarative (content) and procedural (skills) knowledge? Probably, but the specific coaching techniques may vary. For example, verbal and written measures may be used for assessing tutoring content knowledge, whereas observation and demonstration may be more appropriate for assessing tutoring skills. In any case, these questions remain to be empirically demonstrated.

The behavioral, cognitive, and sociocognitive theory and research integrated in the ASK model of peer tutoring suggest some prescriptions for higher education:

1. Students should elaborate on what they know and can do. Elaboration requires integrating and identifying relationships among basic concepts. Small, discrete steps toward complex academic behavior need to be shaped, but should not be terminal measures of learning.

2. As often as possible, academic behavior should be active and shared: Students should speak about, write about, and demonstrate what they know, and be offered thoughtful, constructive feedback that advances their performance. They must collaborate in their own learning.

3. Opportunities should be created for students to produce some academic behavior that can be shaped. These opportunities can be increased by willing, knowledgeable, skilled tutors. As long as classtime is used almost exclusively for information exchange between a single expert and a group of novices, it remains academic time inefficiently spent. Faculty must engage students in the active construction of their own knowledge base and skills by arranging appropriate contingencies for doing so. Peer tutoring is one potential method for accomplishing this goal.

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